Alleviating Bandwidth Constraints by Implementing Quality of Service on Teleport Site Connections

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In the deployed environment, the Marine Corps' data network opens from a handicap. It has to support an amazing and growing amount of users and applications with a limited amount of bandwidth. To illustrate this handicap, most users have high-speed broadband Internet access at home that measures about 5 (or more) megabits per second (Mbps) to support a household of about four users; meanwhile, the Marine Corps supports its warfighters (about 150 users) with a paltry 1.5 Mbps. The Marine Corps' bandwidth achieving transmission systems, satellite and terrestrial, are technologically behind the power curve in keeping up with bandwidth demands.

The Assistant Secretary of Defense for Network Infrastructure and Integration (ASD/NII) along with the Joint Staff J-6 had the foresight to demand that the Defense Information Systems Agency (DISA) upgrade their satellite Standard Tactical Entry Points (STEP). Strategic STEP sites were upgraded to become Teleport sites to support the growing tactical requirements of the warfighter. Teleport sites support the termination of commercial and military band satellite access. The endstate of this upgrade is the Teleport sites can now provide as much bandwidth per service that the warfighter requests.

Moreover, the Marine Corps is going through the world-wide conversion to an all Internet Protocol (IP) environment called

convergence. Specifically, convergent services are defined as the ability to provide voice, video, and data via an IP network. This allows the network to provide and control a multitude of services to support the demands of the user community. Therefore, to alleviate bandwidth constraints and input Marine Corps requirements on DoD Teleport Generation (Gen) II network-centric (net-centric) connections, the Marine Corps must implement quality of service (QoS) on Teleport site connections immediately rather than wait for the employment of Internet Protocol version 6 (IPv6).

Background

The simplest definition of QoS is "a network's capability to deliver resources from end to end quickly and reliably.[1] This concept seems simple but converged networks rely on data to give the perception of real time conversations. These conversations can be via instant message, phone call, video teleconference (VTC), and/or a collaboration tool. Routers process the requests for network resources and enable QoS- no matter if the network is converged or not. Routers can quickly process the millions of resource requests as long as the transmission medium has sufficient bandwidth. As long as there is adequate

[1] SkillSoft, "Implementing Quality of Service," *DISA eLearning Portal*, <https://hr.disa.mil/training/elearning/index.html> (19 February 2008), QoS overview. Cited hereafter as Skillsoft.

bandwidth, the router's QoS mechanism is passive. As soon as this state changes, due to network congestion, the QoS mechanism immediately becomes active and acts in accordance with the policy that is set by the network administrator.

The importance of QoS is most realized when real-time conversations observe latency or delay. The user’s experience during this time is choppy video, lost words in a phone call, and/or dropped call/VTC. Furthermore, QoS is built into the software of routers and thus incurs no added fees to implement.

To relate QoS in terms of combat arms, consider a Fire Direction Center (FDC) that processes fire missions requested by the forward observers (FO). The FDC can process, validate, and approve those missions at a relatively rapid rate even when there is a significant amount of calls for fire (CFF) requested. However, when the amount of simultaneous CFFs requested are above and beyond the FDCs threshold, priority of fire (PoF) is used to determine who gets their mission fired first. The FDC is synonymous to the router; wherein, when that threshold is reached it enacts the PoF or QoS mechanism to ensure that the most important requests (or conversations) are approved first.

Alleviate Bandwidth Constraints

As previously stated, QoS does not come into play if there is sufficient bandwidth between the users. Conversely, the

Marine Corps' tactical transmission mediums have created bottlenecks that are easily apparent due to supporting the growing amount of users and applications. The Marine Corps is attempting to solve this problem by procuring systems with a higher data rate that can terminate Defense Information Systems Network (DISN) services, e.g. Lightweight Mobile SatCom Terminal (LMST) replacing legacy Ground Mobile Forces terminals[2] and the proliferation of the Support Wide Area Network (SWAN).[3] This course of action will not work alone because as long as there is more bandwidth, users will deplete it. By implementing QoS along with legacy and newer transmission systems, the Marine Corps will take a proactive stance in supporting their tactical users with reliable data delivery during network congestion.

QoS is not a new networking technology and has been thoroughly tested and implemented in commercial networks for years. The Assistant Secretary of Defense (Networks and Information Integration) [ASD/NII] had the foresight to understand that the Department of Defense's network had to be flexible and resilient to support the growing requirements of the nation's warfighter. Hence, he tasked DISA to create Net-Centric Implementation Documents (NCID) that relate Global

[2] Director, Headquarters Marine Corps C4, "C4 Campaign Plan," HQMC C4, <https://hqdod.hqmc.usmc.mil/MarineBooklet8Spreads.pdf> (14 December 2007), 34. Cited hereafter as HQMC C4.

[3] Marine Corps Systems Command, PG-12 CINS, Support Wide Area Network, 17 September 2007, <http://www.marcorsyscom.usmc.mil/sites/cins/CNS/Satcom/SWAN.html> (16 December 2007).

Information Grid (GIG) standards for all Services and agencies for networking guidance.

Specifically, NCID T300 created the standard for end-to-end (E2E) QoS interoperability across the GIG.[4] The problem with implementing QoS is getting the necessary network administrators to agree on a matching QoS policy to ensure that one router does not negate the work previously done by another router. In this case, the necessary network administrators are the deployed unit's administrator and DISA's Teleport site that terminates that transmission medium. The aforementioned problem has been alleviated by DISA's IP Change Control Board (IP CCB). The IP CCB is a governing body that adjudicates requests for change to network devices that DISA controls. They are allowing deployed network administrators to submit their desired QoS policy per mission via the Gateway Access Request (GAR).[5] During the GAR authorization process, the Teleport network administrators will configure the appropriate router to support that desired QoS policy. Once that mission has ended, those configurations will be deleted.

[4] DISA, *Global Information Grid Net-Centric Implementation Document: Quality of Service (T300)*, December 2005 (Falls Church, VA), version 2.0. Cited hereafter as NCID T300.
[5] DISA GS21, *DISA IP Change Control Board Agenda*, 31 January 2007 (Falls Church, VA), 10.

Inputting USMC Requirements on the Teleport Sites

In the joint communications arena, the Marine Corps is obviously in last place in planning for and implementing data technologies. The NCID T300 clearly states that the Army, Air Force, and Navy have networking programs that are driving GIG QoS requirements.[6] All of these organizations are implementing technology solutions and levying detailed requirements on the Teleport's architecture. DISA has formulated their plans to implement the Teleport Gen II net-centric architecture. The Marine Corps would be best suited to use this QoS requirement as a launching pad for near-future ideas, plans, testing evolutions, and eventually implementations.

The Marine Corps is as equal a consumer of the Teleport's services as any other Service or agency; therefore, the onus is on Headquarters Marine Corps Command, Control, Communications, and Computers Division (HQMC C4) to ensure that Teleport's equipment supports the requirements and capabilities of the Marine Corps' tactical network. The Joint Staff J6C and US Strategic Command J66 tasked the Marine Corps to ensure that their "requirements are not adversely impacted as a result of IP implementations at DOD Teleports".[7] Unfortunately, HQMC C4's Campaign Plan only speaks about QoS when describing the

[6] NCID T300, 8
[7] Joint Staff J6C and US Strategic Command J66, *DOD Teleport Internet Protocol Concept of Service*, 2006 (Washington, D.C), 13.

initiative to migrate to IPv6 and its overall textbook capabilities.[8] The implication of improved handling infers that QoS must be implemented E2E.[9] This E2E concept will be addressed later.

Marine Corps Network Operations and Security Center, Expeditionary Support (MCNOSC-ES) should be the focal point to start designing tactics, techniques, and procedures (TTPs) for the deployed units to implement QoS. MCNOSC-ES operates with the following mission statement: "In partnership with Marine deployed operating forces and supporting organizations, provide onsite/on call network technical advice and assistance...."[10] In support of that mission, they have Marine and civilian subject matter experts (SMEs) that build, upgrade, and support the Deployed Security Interdiction Devices (DSIDs). The DSIDs are made up of firewalls, switches, routers, and other security devices designed to guard the front door of tactical Marine networks.

Specifically, there are two routers--point of presence and screening--in the DSID that are fully capable of supporting QoS. In today's deployed networking environment, MCNOSC-ES creates the advanced routing portion of the routing configuration to ensure that the deployed networks are optimally secure. MCNOSC-

[8] HQMC C4, 43.
[9] CWO5 Bruce Hodge, conversation with author during COMM OFEC class, 11 October 2007.
[10] "Marine Corps Network Operations and Security Center, Expeditionary Support," <https://www.mcnosc.usmc.mil/Services/Expeditionary+Support/>, (14 December 2007), Mission.

ES has the requisite personnel and expertise to create the necessary QoS policy shell, at a minimum. This QoS policy would be the beginning of the Marine Corps' TTP for QoS that is submitted to Joint Staff J-6 as the USMC requirement for Expeditionary Network (eXNET). The eXNET is the "deployed tactical portion of the Marine Corps Enterprise Network (MCEN)".[11]

Counterargument: Dispel the Myth of Waiting for IPv6

As previously mentioned, HQMC C4 is waiting to implement QoS after IPv6 is rolled out on the MCEN due to IPv6's inherent capabilities. In its simplest definition, IPv6 is an upgrade to the current means of identifying a computer on a network. The upgrade is to the security, advanced services (such as QoS and mobility), and address availability mechanisms within the protocol. From HQMC C4's statement, there is a major misconception that to implement QoS efficiently, QoS must be deployed in an E2E environment. This misconception consists of two points: QoS has to be E2E and IPv4 cannot support the Marine Corps' QoS needs like IPv6.

To understand the concept of a true E2E QoS environment, one has to visualize the disparate networks involved. For example, a QoS-enabled, VoIP call between a deployed MEU

[11] HQMC C4, 9.

commander and a MEF CG (in garrison) physically transits three separately administered networks. The first network is the MCEN's eXNET; wherein the USMC has complete control. The second is the GIG-Bandwidth Expansion (GIG-BE), which is inclusive of the Teleport site, the DISN Core (DoD's network core architecture); and the legacy IP network that connects the garrison network to the rest of the DoD and Internet. Joint Task Force- Global Network Operations (JTF-GNO) and DISA jointly have responsibility of the GIG-BE. Last, the NMCI, administered by Electronic Data Systems (EDS) Corporation, provides the garrison network architecture.

For true E2E QoS, all three administrators would have to agree on a common QoS policy. The problem is EDS is not willing to offer any extra services without a change to the current NMCI contract which means extra money. To mitigate fighting with multiple administrators, the Marine Corps can focus its efforts on the highest need portion of the network, the connection to the Teleport sites. By implementing the differentiated services[12] portion of QoS, the DSID and Teleport routers will prioritize conversations (based on QoS policy's TTP) while other routers treat all traffic as best effort.[13]

[12] Differentiated services: one of the two methods, along with integrated services, of implementing QoS. In differentiated services, each packet is subject to each router's QoS policy from end to end. Skillsoft, QoS overview.
[13] Best effort: QoS term used to describe whether the QoS mechanism is in active or passive mode. The router is in passive mode when there is sufficient outbound bandwidth to support the network's resource requests. Skillsoft, QoS architecture.

The second point is that the QoS mechanism is not drastically different between IPv6 and IPv4 (current version). The portion of the IP packet that the router uses to identify QoS conversations in an IPv6 and IPv4 packet are identical.[14] The upgrades to the protocol, in support of QoS, are to enhance E2E communications. On the other hand, MCNOSC-ES SMEs should be able to use creative designing to overlay an E2E solution to alleviate a major network chokepoint, the Teleport connections. Implementing QoS on this segment will support the tactical user's request now rather than waiting for an E2E design solution that is years away from fruition.

Conclusion

In comparison with the other Services, the Marine Corps is obviously behind the technological power curve in the planning for and implementation of a converged MCEN. Tactical users are and will continue to suffer the effects of an overtaxed network. The implementation of QoS is a necessary component in providing the optimal user experience for high priority traffic. Additionally, the Marine Corps must become an active player in the joint, interagency communications community via Joint Staff J-6 and ASD/NII. DISA’s Teleport program is working very hard to support the warfighter community, especially during this time

[14] Cisco IPv6 Fundamentals, Design, and Deployment (Canada: Cisco Press, 2006), version 2.0, 1:5-5 to 5-6.

of war. The lack of depth in the Marine Corps' budget should not be a limiting factor in this case. The only cost to implement QoS on Teleport site connections is time and subject matter expertise. Both factors are well within HQMC C4's reach. The endstate is that senior leadership must make it an essential task.

1981 words

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